

The documentation and process conversion measures necessary to comply with this revision shall be completed by 10 Dec 93.

INCH-POUND

MIL-S-19500/354D
10 September 1993
SUPERSEDING
MIL-S-19500/354C
21 June 1983

MILITARY SPECIFICATION
SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, LOW-POWER
TYPES 2N2604 AND 2N2605, JANTX, JANTXV, AND JANS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the detail requirements for PNP, silicon, low-power transistors for use in low noise-level amplifier applications. Three levels of product assurance are provided for each device type as specified in MIL-S-19500.

1.2 Physical dimensions. See 3.3.

1.3 Maximum ratings.

Type	$P_T \frac{1}{T_A = +25^\circ\text{C}}$	V_{CBO}	V_{EBO}	V_{CEO}	I_C	T_J and T_{STG}	$R_{\theta JA}$
2N2604	$\frac{\text{mW}}{400}$	$\frac{\text{V dc}}{80}$	$\frac{\text{V dc}}{6}$	$\frac{\text{V dc}}{60}$	$\frac{\text{mA dc}}{30}$	$\frac{^\circ\text{C}}{-65 \text{ to } +200}$	$\frac{^\circ\text{C/mW}}{.437}$
2N2605	$\frac{\text{mW}}{400}$	$\frac{\text{V dc}}{70}$	$\frac{\text{V dc}}{6}$	$\frac{\text{V dc}}{60}$	$\frac{\text{mA dc}}{30}$	$\frac{^\circ\text{C}}{-65 \text{ to } +200}$	$\frac{^\circ\text{C/mW}}{.437}$

1/ Derate linearly at 2.28 mW/°C above $T_A = +25^\circ\text{C}$.

1.4 Primary electrical characteristics.

	h_{FE1}	h_{fe}	$ h_{fe} $	C_{obo}	$V_{BE(sat)}$	$V_{CE(sat)}$
	$V_{CE} = 5 \text{ V dc}$ $I_C = 10 \mu\text{A dc}$	$V_{CE} = 5 \text{ V dc}$ $I_C = 1 \text{ mA dc}$ $f = 1 \text{ kHz}$	$V_{CE} = 5 \text{ V dc}$ $I_C = 500 \mu\text{A dc}$ $f = 30 \text{ MHz}$	$V_{CB} = 5 \text{ V dc}$ $I_E = 0$ $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	$I_C = 10 \text{ mA dc}$ $I_B = 500 \mu\text{A dc}$	$I_C = 10 \text{ mA dc}$ $I_B = 500 \mu\text{A dc}$
	2N2604	2N2605	2N2604	2N2605		
Min	40	100	60	150	1	
Max	120	300	180	450	8	
					pF	
					$\frac{\text{V dc}}{0.7}$	$\frac{\text{V dc}}{0.3}$
					0.9	

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, US Army Research Laboratory, ATTN: AMSRL-EP-RD, Fort Monmouth, NJ 07703-5601 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 5961

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards and handbooks. The following specifications, standards and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

MILITARY

MIL-S-19500 - Semiconductor Devices, General Specification for.

STANDARD

MILITARY

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Order of precedence. In the event of a conflict between the text of this document and the references cited herein the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Associated detail specification. The individual item requirements shall be in accordance with MIL-S-19500, and as specified herein.

3.2 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-S-19500.

3.3 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-S-19500, appendix F, figure 9, T-2B.

3.3.1 Lead finish. Lead finish shall be solderable in accordance with MIL-S-19500. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

3.4 Marking. Marking shall be in accordance with MIL-S-19500.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-S-19500.

4.3 Screening (JANS, JANTX, and JANTXV levels only). Screening shall be in accordance with table II of MIL-S-19500, and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table II of MIL-S-19500)	Measurement	
	JANS level	JANTX and JANTXV levels
9	I_{CB01} and h_{FE1}	Not applicable
11	I_{CB01} ; h_{FE1} ; ΔI_{CB01} = 100 percent or 2 nA dc, whichever is greater; Δh_{FE1} = ± 25 percent change of initial value.	I_{CB01} and h_{FE1}
12	See 4.2.1	See 4.2.1
13	Subgroups 2 and 3 of table I herein; ΔI_{CB01} = 100 percent or 2 nA dc, whichever is greater; Δh_{FE1} = ± 25 percent change of initial value.	Subgroup 2 of table I herein; ΔI_{CB01} = 100 percent or 2 nA dc, whichever is greater; Δh_{FE1} = ± 25 percent change of initial value.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows:

V_{CB} = 25 V dc; P_T = 400 mW at T_A = room ambient as defined in 4.5 of MIL-STD-750.

NOTE: No heat sink or forced air cooling on the devices shall be permitted.

4.4 Quality conformance inspection. Quality conformance inspection shall be in accordance with MIL-S-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-S-19500, and table I herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IVa (JANS) and table IVb (JANTX and JANTXV) of MIL-S-19500. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps and footnotes of table I, group A, subgroup 2 herein.

4.4.2.1 Group B inspection, table IVa (JANS) of MIL-S-19500.

Subgroup	Method	Condition
B4	1037	V_{CB} = 20 V dc; P_T = 400 mW at T_A = room ambient as defined in 4.5 of MIL-STD-750; t_{on} = t_{off} = 3 minutes minimum for 2,000 cycles. No heat sink or forced-air cooling on devices shall be permitted.
B5	1027	V_{CB} = 20 V dc; T_A = $+125^\circ\text{C} \pm 25^\circ\text{C}$ for 96 hours, P_T = 400 mW at T_A = $+100^\circ\text{C}$ or adjusted as required by the chosen T_A to give an average lot. T_J = $+275^\circ\text{C}$.

4.4.2.2 Group B inspection, table IVb (JANTX and JANTXV) of MIL-S-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B3	1027	$V_{CB} = 25 \text{ V dc}$; $P_T = 400 \text{ mW}$ at $T_A = \text{room ambient}$ as defined in 4.5 of MIL-STD-750. No heat sink or forced-air cooling on the devices shall be permitted.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table V of MIL-S-19500. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps and footnotes of table I, group A, subgroup 2 herein.

4.4.3.1 Group C inspection, table V of MIL-S-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition E
C6	1026	$V_{CB} = 25 \text{ V dc}$; $P_T = 400 \text{ mW}$ at $T_A = \text{room ambient}$ as defined in 4.5 of MIL-STD-750. No heat sink or forced-air cooling on device shall be permitted.
C7	3131	$R_{\theta JA} = .437^\circ\text{C/mW}$. LTPD = 15.

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Noise figure. The noise figure shall be measured using commercially available test equipment and its associated standard test procedures.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-S-19500.

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical examination	2071					
<u>Subgroup 2</u>						
Collector - base breakdown voltage 2N2604 2N2605	3001	Bias condition D; $I_C = 10 \mu A$ dc	$V_{(BR)CBO}$	80 70		V dc V dc
Collector - emitter breakdown voltage	3011	Bias condition D; $I_C = 10$ mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	60		V dc
Emitter - base breakdown voltage	3026	Bias condition D; $I_E = 10 \mu A$ dc	$V_{(BR)EBO}$	6		V dc
Collector - base cutoff current	3036	Bias condition D; $V_{CB} = 50$ V dc	I_{CB01}		10	nA dc
Emitter - base cutoff current	3061	Bias condition D; $V_{EB} = 5$ V dc	I_{EBO}		2	nA dc
Collector - emitter cutoff current	3041	Bias condition C; $V_{CE} = 50$ V dc	I_{CES}		10	nA dc
Forward current transfer ratio 2N2604 2N2605	3076	$V_{CE} = 5$ V dc; $I_C = 10 \mu A$ dc	h_{FE1}	40 100	120 300	
Forward current transfer ratio 2N2604 2N2605	3076	$V_{CE} = 5$ V dc; $I_C = 500 \mu A$ dc	h_{FE2}	60 150	180 450	
Forward current transfer ratio 2N2604 2N2605	3076	$V_{CE} = 5$ V dc; $I_C = 10$ mA dc	h_{FE3}	40 100	160 400	
Base - emitter voltage (saturated)	3066	Test condition A; $I_C = 10$ mA dc; $I_B = 500 \mu A$ dc	$V_{BE(sat)}$	0.7	0.9	V dc
Collector - emitter voltage (saturated)	3071	$I_C = 10$ mA dc; $I_B = 500 \mu A$ dc	$V_{CE(sat)}$		0.3	V dc

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 3						
High-temperature operation:		$T_A = +150^{\circ}\text{C}$				
Collector - base cutoff current	3036	Bias condition D; $V_{CB} = 50\text{ V dc}$	I_{CBQ2}		5	$\mu\text{A dc}$
Low-temperature operation:		$T_A = -55^{\circ}\text{C}$				
Forward current transfer ratio 2N2604 2N2605	3076	$V_{CE} = 5\text{ V dc};$ $I_C = 10\text{ }\mu\text{A dc}$	h_{FE4}	15 30		
Subgroup 4						
Small-signal short-circuit input impedance 2N2604 2N2605	3201	$V_{CB} = 5\text{ V dc};$ $I_C = 1\text{ mA dc}; f = 1\text{ kHz}$	h_{ie}	1 2	10 20	$k\Omega$ $k\Omega$
Small-signal open-circuit reverse-voltage transfer ratio	3211	$V_{CE} = 5\text{ V dc};$ $I_C = 1\text{ mA dc};$ $f = 1\text{ kHz}$	h_{re}		10 x	10^{-4}
Small-signal open-circuit output admittance 2N2604 2N2605	3216	$V_{CE} = 5\text{ V dc};$ $I_C = 1\text{ mA dc}; f = 1\text{ kHz}$	h_{oe}		40 60	μmhos μmhos
Small-signal short-circuit forward-current transfer ratio 2N2604 2N2605	3206	$V_{CE} = 5\text{ V dc};$ $I_C = 1\text{ mA dc}; f = 1\text{ kHz}$	h_{fe}	60 150	180 450	
Magnitude of common emitter small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 5\text{ V dc};$ $I_C = 0.5\text{ mA dc};$ $f = 30\text{ MHz}$	$ h_{fe} $	1	8	
Open capacitance input open circuited	3236	$V_{CB} = 5\text{ V dc}; I_E = 0;$ $100\text{ kHz} \leq f \leq 1\text{ MHz}$	C_{obo}		6	pF
Noise figure	3246	$V_{CE} = 5\text{ V dc}; I_C = 10\text{ }\mu\text{A dc};$ $R_g = 10\text{ k}\Omega; f = 100\text{ Hz}$	F_1		5	dB
Noise figure	3246	$V_{CE} = 5\text{ V dc}; I_C = 10\text{ }\mu\text{A dc};$ $R_g = 10\text{ k}\Omega; f = 1\text{ kHz}$	F_2		3	dB
Noise figure	3246	$V_{CE} = 5\text{ V dc}; I_C = 10\text{ }\mu\text{A dc};$ $R_g = 10\text{ k}\Omega; f = 10\text{ kHz}$	F_3		3	dB

1/ For sampling plan, see MIL-S-19500.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Notes. The notes specified in MIL-S-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Issue of DODISS to be cited in the solicitation.
- b. Lead formation and finish as specified (see 3.3.1).
- c. Type designation and product assurance level.

6.3 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

CONCLUDING MATERIAL

Custodians:

Army - ER
Navy - EC
Air Force - 17
NASA - NA

Review activities:

Army - AR, AV, MI
Navy - AS, CG, MC
Air Force - 13, 15, 19, 85
DLA - ES

Preparing activity:

Army - ER

Agent:

DLA - ES

(Project 5961-1469)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
MIL-S-19500/3540

2. DOCUMENT DATE (YYMMDD)

3. DOCUMENT TITLE

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, LOW-POWER, TYPES 2N2604 AND 2N2605, JANTX, JANTXV, AND JANS

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)

7. DATE SUBMITTED
(YYMMDD)

(1) Commercial

(2) AUTOVON
(If applicable)

8. PREPARING ACTIVITY

a. NAME

b. TELEPHONE (Include Area Code)

(1) Commercial

(2) AUTOVON

c. ADDRESS (Include Zip Code)

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:

Defense Quality and Standardization Office

5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466

Telephone (703) 756-2340 AUTOVON 289-2340